

# TCC Configuration Requirements

NIF User Forum

With input from:  
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# Requirements include:

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## 1. TaLIS requirements from TaLIS Configuration Assessments Guidance Document.

- 3w beam capture by target
- 3w beam clearance to target features
- 1w light clearance to target features

## 2. Alignment Team requirements (Sept 2018)

- Positioner clearance
- Targets to TAS
- Diagnostics to 1w light
- Diagnostics to shroud

# TaLIS: 3w beam capture by target feature

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Definition for 3w beam capture by a target feature: A beam focal spot is considered to be fully captured on the target provided it is:

- (1) incident on the target substrate with at least 0.5 mm clearance from the 10% threshold to the edge of the target substrate (measured orthogonal to the beam) and
- (2) incident with an angle  $<70$  degrees wrt the target normal

# TaLIS: 3w beam clearance to target features

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Definition for 3w beam clearance to a target feature: A beam focal spot is considered to clear a target component provided the 1% threshold of the beam spot is  $>0.5$  mm (measured orthogonal to the beam) plus clearance allowing for up to 0.5 degrees metrology/alignment/positioning tolerance from the target component

Rule: If the beam focal spot is incident either closer to the edge than required to be 'fully captured', incident at an angle  $>70$  deg relative to the target normal, or closer to the target component than required to 'clear' the target, then the configuration must be assessed for blow-by by the backscatter working group

# TaLIS: 1w light clearance to target features

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Definition: 1w footprint clears the target feature if 10% threshold of the beam spot is  $>0.2$  mm (measured normal to the beam) plus clearance allowing for up to 0.5 degrees metrology/alignment/positioning tolerance from the target component

- Note – the 10% threshold for the 1w beam footprint is offset 4.45 mm from the 3w aim point (normal to the beam)
- There is no concern for 1w light that clears the target feature
- If 1w beam footprint does not fully clear the target, the configuration needs to be evaluated for unconverted light management. (See the following slide.)
- ARC beam shall not intersect with a NIF beam foot print on a target feature

# TaLIS: Managing 1w light on target features

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If 1w light does not clear the target, then it must be managed to prevent scatter into open FOAs:

1. Target surfaces that are not cleared by 1w beam footprints must be curved to scatter the 1w light:

- < 2 mm radius of curvature for cylindrical target components (e.g. stalks)
- < 5 mm radius of curvature for spherical dimpling

2. If a target surface that is not cleared by 1w beam footprints is not dimpled (per above) then the specular 1w reflection from that surface shall not approach within 20 degrees of any open quad (FOA).

If a target surface that is not cleared by 1w beam footprints is not dimpled, and specular 1w reflection from that surface approaches within 20 degrees of any open quad, the configuration requires additional review and may not be allowed.

# A minimum clearance is defined to assure that the final alignment is safe during shot execution

## Positioner Clearance 25mm or 35 mm

Target & diagnostic hardware shall maintain a minimum clearance of

- **25 mm within CIVS NFOV**  
(from TCC, NFOV = <120 mm TANDM-124, <150 mm all others)
- **35 mm outside the CIVS NFOV**

## Targets to TAS 5 mm & 10 mm

Targets shall maintain a minimum clearance to TAS of

- **5 mm above / below** the target
- **10 mm radially** (including insertion / retraction)

## Diagnostics to 1w Light 10 mm – 25 mm

Diagnostic hardware shall maintain a minimum clearance to 1w unconverted light, as defined by a cone of

- **10 mm** at TCC extruded to 25 mm at 1 m from TCC

## Diagnostic to shroud 10 mm

Diagnostic hardware shall maintain a minimum clearance to the target shroud swept volume of

- **10 mm**

REMS-approved positioner clearance requirements will be available in ELM (1004566047)

# The minimum design clearance is based on the alignment sequence and CIVS camera views

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- DIM-based diagnostics are aligned individually
  - Inserted to TCC and aligned with OPAS/CIVS/ATLAS
  - Final position verified relative to expected with CIVS
  - Parked to free-up TCC for subsequent alignments
  - Reinserted in defined order, prior to shot
- Target is inserted to TCC with TAS in place
  - Diagnostics re inserted after TAS retraction
- TANDM-124 and PDIM are aligned last
- The CIVS views provide limited visibility
  - It is difficult to clearly identify the edges of the snouts or the target stalk

# High-precision, non-standard, complicated diagnostics require unique procedures & sequences

- CBI, VISAR-C, XRD(t):
  - Unique sequence due to potential interference with target
  - High-precision alignment
- KBO, NIS:
  - High-precision alignment; unique alignment procedures
- OTS, VISAR:
  - Unique alignment sequence (on-board camera used)
- NIS-3:
  - Unique sequence, unique manipulator
  - High-precision alignment
- NSA Hardware:
  - Larger than normal instruments, typically close to TCC

Unique alignment procedures typically take longer and often introduce increased risk

## Shot configurations with min. clearance between positioners requires more review – engage TaLIS early

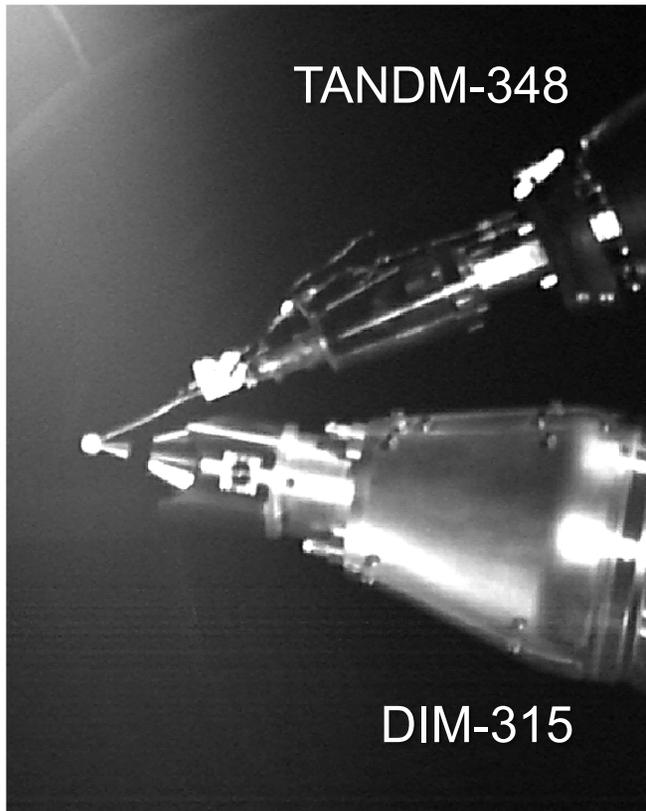
Any configuration will require additional time to review:

- where the **clearance between positioners is close to 25 mm** often requires engineering involvement to model expected clearances
- with a **target on CTARPOS-015 and a diagnostic on TANDM-348**
  - often requires engineering involvement to model expected clearances
- with a **target or diagnostic on TANDM-348 and a diagnostic on DIM-315**
  - often requires engineering involvement to model expected clearances
- where there is **increased risk of positioner interference or the clearances are small** will require special alignment procedures

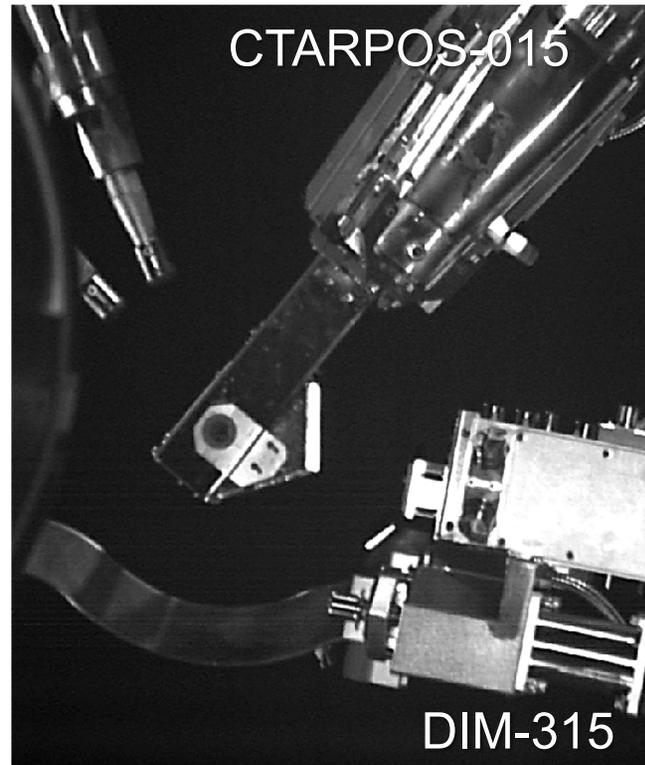
Any configuration that introduces increased risk will required additional time review / prepare

# Examples of off-normal configurations that required significant review & special procedures for every use

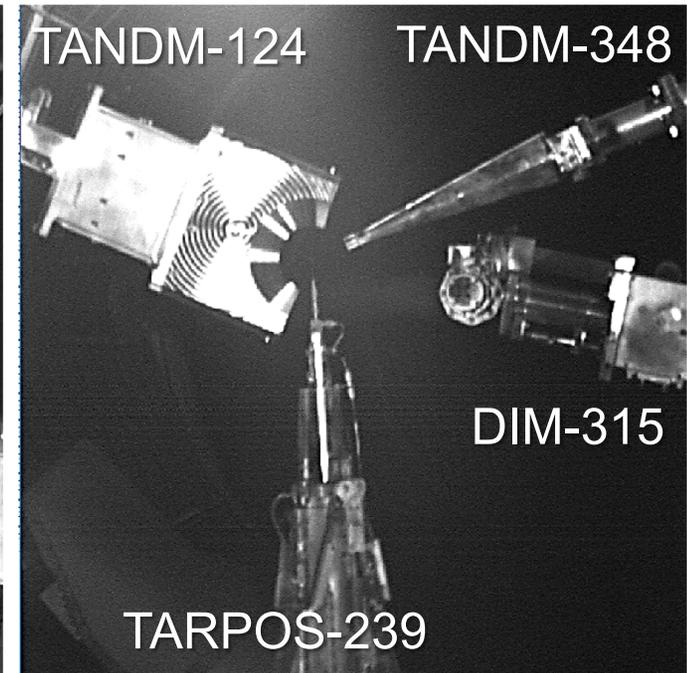
## VISAR-C



## CBI



## NED (Single use only)



Configurations do not meet standard positioner clearance ROE, engineered controls (interlocks) combined with special procedures used to manage risk – req. 4-9 months advanced discussions

# Who can help?

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- TaLIS
  - [talis-members@llnl.gov](mailto:talis-members@llnl.gov)
- Alignment
  - [Diagnostic\\_Alignment\\_SMEs@llnl.gov](mailto:Diagnostic_Alignment_SMEs@llnl.gov)
  - [Target\\_Alignment\\_SMEs@llnl.gov](mailto:Target_Alignment_SMEs@llnl.gov)



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# There is limited space inside TAS for targets

- The maximum size target that can be inserted in TAS during beam alignment is a height of approx 38 mm
  - No component can extend more than 19 mm above the lowest aim-point for an upper beam
  - No component can extend more than 19 mm below the highest aim-point for a lower beam
  - Violating the stay-in zone may require a different alignment sequence or may require different beam selection
- The maximum size target that can be inserted into TAS and still allow TAS to be withdrawn is a cylinder :

Positioner	Cylinder radius (mm)	Target Height (mm)
TARPOS (90-239)	60	38
TANDM (90-348)	60	38
C-TARPOS (90-015)	29	38

# What can the selection of the positioner affect?

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- Diagnostic Positioners can affect
  - Closest approach to TCC
  - Stability
  - Shot Cycle Duration
- Target positioner can affect
  - Target design
  - Diagnostics on nearest positioners

# Clearance is required between positioners at all times during a shot cycle

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- Positioners (including target or diagnostic hardware) shall maintain a minimum clearance of
  - **25 mm** within the CIVS NFOV
    - **<120 mm** from TCC for TANDM 124
    - **<150 mm** from TCC for all other positioners
  - **35 mm** outside the CIVS NFOV
- Targets shall maintain a minimum clearance to **TAS** of
  - **5 mm** above / below the target
  - **10 mm radially** (including insertion / retraction)
- Diagnostic hardware shall maintain a minimum clearance to **1w** unconverted light, as defined by a cone of
  - **10 mm** at TCC extruded to **25 mm** at 1 m from TCC
- Diagnostic hardware shall maintain a minimum clearance to the target shroud swept volume of
  - **10 mm**